

**WHAT IS CLAIMED IS:**

1. A speech-based virtual audio distance display device comprising:

a first external input comprising a control computer interface that determines a desired distance of a simulated sound source from an external system driving said display;

a second external input comprising operator selection of a desired listening level;

a non-volatile memory device storing a plurality of pre-recorded speech signals;

a variable mode vocal effort processor determining an appropriate pre-recorded speech signal for a specific application from said non-volatile memory device storing a plurality of pre-recorded speech signals based on said first and second external inputs;

a synthesized speech utterance absolute output level controlling calibration factor scaling said appropriate pre-recorded speech signal output to a listener in accordance with said second external input; and

a head related transfer function virtual audio display processing a signal output from said synthesized speech utterance output level controlling calibration factor and presenting said signal to a listener via headphones.

2. The speech-based virtual audio distance display device of claim 1, wherein said pre-recorded speech signals are comprised of

a single utterance across a wide range of vocal effort levels.

3. The speech-based virtual audio distance display device of claim 1, wherein said head related transfer function virtual audio display further comprises head related transfer functions adding directional cues to a signal output from said synthesized speech utterance output level controlling calibration factor.

4. The speech-based virtual audio distance display device of claim 1 wherein said synthesized speech utterance output controlling calibration factor further comprises:  
amplitude of digital signals stored in audio display relative to amplitude of the audio signal produced at the listener's ears when those signals are converted to analog form and output to the listener through headphones.

5. The speech-based virtual audio distance display device of claim 1 wherein said variable mode vocal effort processor further comprises a first and second mode, said first mode comprising:

an utterance selection that exactly matches a signal the listener would hear if a live talker were located at a distance  $D$  in a free field environment.

6. The speech-based virtual audio distance display device of claim 5 wherein said second mode of said variable mode vocal effort processor comprises:

psychoacoustic data used to select a calibration factor that produces a sound perceived at the same distance as a visual object located  $D$  meters from the listener.

7. The speech-based virtual audio distance display device of claim 1 wherein said second external input comprises operator selection using a manual control knob.

8. The speech-based virtual audio distance display device of claim 1 further comprising a D/A converter for converting a signal output from said synthesized speech utterance output level controlling calibration factor from digital to analog.

9. The speech-based virtual audio distance display device of claim 1 wherein said variable mode vocal effort processor comprises a first mode wherein said processor selects the utterance that will exactly match the signal the listener would hear if a live talker were located a preselected distance D in a free field.

10. The speech-based virtual audio distance display device of claim 1 wherein said variable mode vocal effort processor comprises a second mode wherein said processor uses psychoacoustic data to select the level of vocal effort that will produce a sound perceived at the same distance as a visual object located a distance D from the listener.

11. A method for providing a speech-based auditory distance display comprising the steps of:

first externally inputting a desired distance of a simulated sound source from an external system driving said display;

second externally inputting a desired listening level;

storing a plurality of pre-recorded speech signals in a non-volatile memory device;

determining an appropriate pre-recorded speech signal for a specific application from said non-volatile memory device storing a plurality of pre-recorded speech signals

based on said first and second external inputs using a variable mode vocal effort processor;

scaling said appropriate pre-recorded speech signal output to a listener in accordance with said second external input using a synthesized speech utterance output level controlling calibration factor; and

processing a signal output from said synthesized speech utterance absolute output level controlling calibration factor with head related transfer functions adding directional cues to said signal and presenting said signal to a listener via headphones.

12. The method of claim 11 for providing a speech-based auditory distance display wherein said storing step further comprises the step of storing a plurality of pre-recorded speech signals comprising a single utterance across a wide range of vocal effort levels in a non-volatile memory device.

13. The method of claim 11 for providing a speech-based auditory distance display wherein said storing step further includes storing a plurality of pre-recorded speech signals comprised of a single utterance in a non-volatile memory device.

14. The method of claim 11 for providing a speech-based auditory distance display wherein said scaling step further comprises:

comparing amplitude of digital signals stored in audio display relative to amplitude of the audio signal produced at the listeners ears, and

converting an output from said comparing step to analog form and outputting to a listener through headphones.

15. The method of claim 11 for providing a speech-based auditory distance display wherein said variable mode vocal effort processor further comprises a first and second mode, said first mode comprising an utterance selection that exactly matches a signal the listener would hear if a live talker were located at a distance  $D$  in a free field environment.

16. The method of claim 11 for providing a speech-based auditory distance display wherein said second mode of said variable mode vocal effort processor comprises psychoacoustic data used to select a calibration factor that produces a sound perceived at the same distance as a visual object located  $D$  meters from the listener.

17. The method of claim 11 for providing a speech-based auditory distance display wherein said pre-recorded speech signals from said storing step are obtained by employing the steps comprising:

prompting a talker to repeat a particular utterance by providing a loudspeaker with a recording of a desired utterance at a center of an anechoic chamber;

providing a pressure microphone in said anechoic chamber wherein a talker repeats said utterance at an appropriate level of vocal effort; and

controlling said steps for obtaining pre-recorded speech signals using a personal computer located in a control room, said personal computer prompting a listener for each utterance and recording said utterance to disk for later integration into said auditory distance display and repeating said steps of prompting and providing for each vocal effort level ranging from a whisper to a shouted voice.

18. The method of claim 17 for providing a speech-based auditory distance display further including the steps of:

- inspecting each of said pre-recorded speech signals;
- truncating each signal from beginning to end;
- eliminating differences in microphone power gain from said speech signals; and
- calculating a vocal effort of each utterance by comparing its overall RMS power to a RMS or prerecorded calibration tone.

19. The method of claim 11 for providing a speech-based auditory distance display wherein said step of externally inputting further comprises the step of manually operating a listening level selectable control knob.

20. The method of claim 11 for providing a speech-based auditory distance display further including a step of converting a signal output from said scaling step from digital to analog using a D/A converter.